Japanese Unexamined Patent Publication No. 318516/1992 (*Tokukaihei* 4-318516)

A. Relevance of the Above-identified Document

The following is a partial English translation of exemplary portions of non-English language information that may be relevant to the issue of patentability of the claims of the present application.

B. Translation of the Relevant Passages of the Document

See also the attached English Abstract.

[0010] Fig. 1 illustrates the present invention applied to a liquid crystal panel drive device for use in a liquid crystal television or the like, and the members identical to those of Fig. 3 are given the same symbols and the explanations therefor are omitted. As illustrated in Fig. 1, a thermo sensor 11 is provided to a liquid crystal panel 8. A detection signal of this thermo sensor 11 is digitalized by an A/D converter 12 and is transmitted to mode input terminals of a data converting circuit 13. The data converting circuit 13 compares (i) image data from the A/D converter 3, which data is given to input terminals "New" (i.e. A3 to A5) with (ii) one-frame preceding image data read out from a RAM 4, which data is given to input terminals "Old" (i.e. A0 to A2), and outputs as image data from an output terminal P, sets of image data D0 to D2

which are based on mode signals Mh, Mm, and M1 each of which signals respectively input via input terminals A6 to A8. This output is basically performed in compliance with the following rules. Namely:

$$\text{New} > \text{Old} \rightarrow P = \text{New} + \alpha$$

$$\text{New} = \text{Old} \rightarrow P = \text{New}$$

$$\text{New} < \text{Old} \rightarrow P = \text{New} - \alpha$$

The value of α is adjusted according to the mode signals.

[0011] Next, the operation of the above described example is explained. Here, the temperature of the liquid crystal panel 8 detected by the thermo sensor 11 is classified into three values of Th, Tm, and T1 (where Th >Tm >T1), and corresponding mode signals output from the A/D converter 12 to the data converting circuit 13 are the mode signals Mh, Mm, and M1, respectively. The ROM 23 of the data converting circuit 13 stores beforehand tables of image data whose address is designated by the current image data and one-frame preceding image data, the number of which tables corresponds to the number of mode signals: i.e., three. A table is selected according to a mode signal input, and image data, in the selected table, which is written in an address designated by the current image data and the one-frame preceding image data, and which complies the above described rules is read out, and is output to a segment drive circuit 7.

[0012] In the following, it is assumed that the A/D converter 3 is A RAM4, and image data to be output to the data converting circuit 13 is 3bit data representing grayscale levels of "0" to "7". It is further assumed that the grayscale level of the one-frame preceding image data which is given to the input terminals "Old" of the data converting circuit 13 is "0", and that the grayscale level of the image data input from the A/D converter 3 to the input terminals "New" is "4". When the temperature of the liquid crystal panel 8, which is detected by the thermo sensor 11, is Tm, the mode signal from the A/D converter 12 to the data converting circuit 13 is Mm. As such, from the table of image data corresponding to the mode signal Mm, the data converting circuit 13 reads out, from the table corresponding to the mode signal Mm, emphasis-use image data "6" which is in the address designated by the one-frame preceding image data "0" and the current data "4". The read out image data "6" is then output to the segment drive circuit 7, for the purpose of driving the liquid crystal panel 8.

[0013] Further, when: (i) the grayscale levels of the one-frame preceding image data and the current image data are respectively "0" and "4" as in the above case; and (ii) the temperature of the liquid crystal panel 8 detected by the thermo sensor 11 is Th (where Th > Tm), the mode signal from the A/D converter 12 to the data converting

circuit 13 is Mh, and the data converting circuit 13 reads out, from the table corresponding to the mode signal Mh, emphasis-use image data "5" which is in the address designated by the one-frame preceding image data "0" and the current data "4". The read out image data "5" is then output to the segment drive circuit 7, for the purpose of driving the liquid crystal panel 8. Here, the liquid crystal material used in the liquid crystal panel 8 has temperature dependency, and its response speed in relation to a change in the grayscale level becomes faster with an increase of its temperature. Transmitting excessively emphasized image data to the liquid crystal panel 8 having a high temperature causes displaying of an unnatural image, and this needs to be prevented. This is why the grayscale of the image data bound to the liquid crystal panel 8 in the previously stated case is higher than this case where the temperature of the liquid crystal panel 8 is Th.

[0014] Similarly, when: (i) the grayscale levels of the one-frame preceding image data and the current image data are respectively "0" and "4" as in the above case; and (ii) the temperature of the liquid crystal panel 8 detected by the thermo sensor 11 is T1 (where $T1 < Tm < Th$), the mode signal from the A/D converter 12 to the data converting circuit 13 is M1, and the data converting circuit 13 reads out, from the table corresponding to the

mode signal M1, emphasis-use image data "7" which is in the address designated by the one-frame preceding image data "0" and the current data "4". The read out image data "7" is then output to the segment drive circuit 7, for the purpose of driving the liquid crystal panel 8. Here, as described above, the liquid crystal material used in the liquid crystal panel 8 has temperature dependency, and its response speed in relation to a change in the grayscale level becomes slower with a decrease of its temperature. On this account, the image data which is the maximum grayscale level of "7" is output to sufficiently carry out emphasis process with respect to the liquid crystal panel 8, so as to accelerate the response speed in relation to a change in a grayscale level, thereby causing the liquid crystal to swiftly follow the rapidly changing image.

[0015] In the above described was the case where the grayscale level has risen from "0" of the one-frame preceding image data to "4" of the current image data. The following deals with a case where the grayscale level drops. For example, it is assumed that the grayscale level of the one-frame preceding image data which is given from the RAM 4 to the input terminals "Old" of the data converting circuit 13 is "7", and that the grayscale level of the image data input from the A/D converter 3 to the input terminals "New" is "4". When the temperature of the liquid crystal panel 8 detected by the thermo sensor 11 is Tm,

the mode signal from the A/D converter 12 to the data converting circuit 13 is Mm. As such, from the table of image data corresponding to the mode signal Mm, the data converting circuit 13 reads out, from the table corresponding to the mode signal Mm, emphasis-use image data "1" which is in the address designated by the one-frame preceding image data "7" and the current data "4". The read out image data "1" is then output to the segment drive circuit 7, for the purpose of driving the liquid crystal panel 8.

[0016] Further, when: (i) the grayscale levels of the one-frame preceding image data and the current image data are respectively "7" and "4" as in the above case; and (ii) the temperature of the liquid crystal panel 8 detected by the thermo sensor 11 is Th (where Th > Tm), the mode signal from the A/D converter 12 to the data converting circuit 13 is Mh, and the data converting circuit 13 reads out, from the table corresponding to the mode signal Mh, emphasis-use image data "3" which is in the address designated by the one-frame preceding image data "7" and the current data "4". Here, as mentioned before, the temperature dependency of the liquid crystal panel 8 is considered, and displaying of an unnatural image is avoided by not transmitting excessively emphasized image data to the liquid crystal panel 8 having a high temperature.

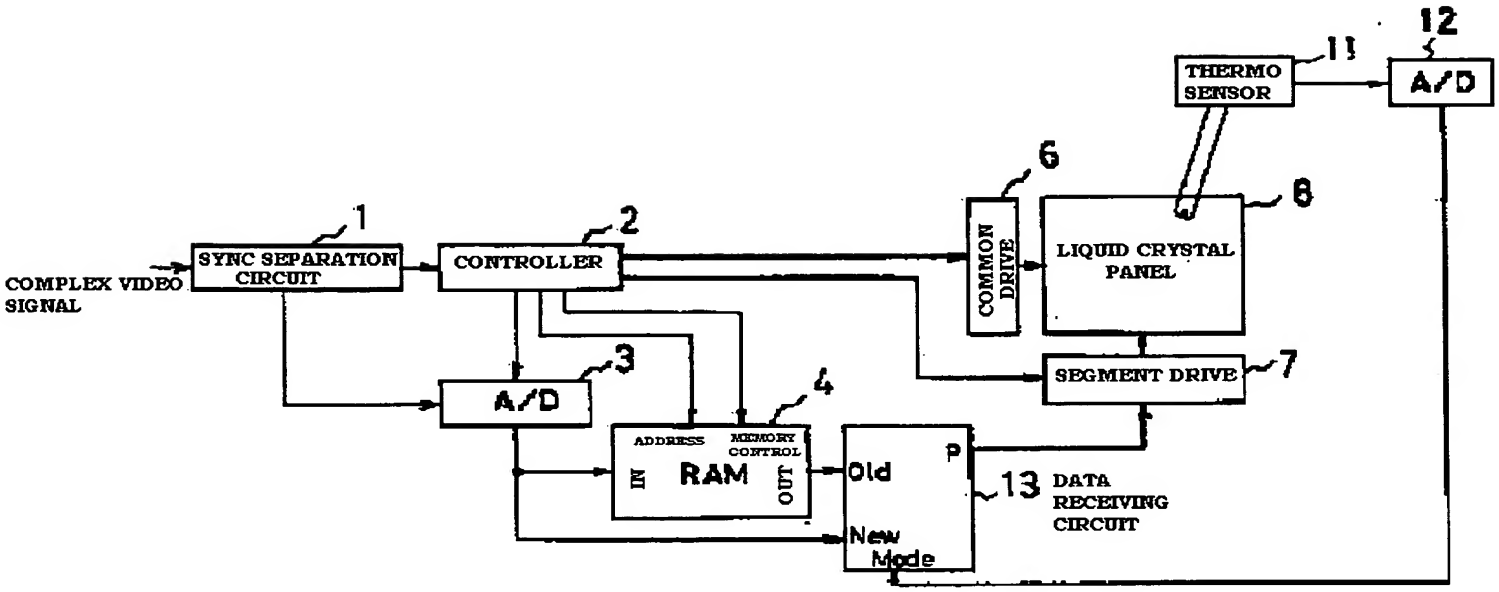
[0017] Similarly, when: (i) the grayscale levels of the one-frame preceding image data and the current image data are respectively "7" and "4" as in the above case; and (ii) the temperature of the liquid crystal panel 8 detected by the thermo sensor 11 is T1 (where T1 < Tm < Th), the mode signal from the A/D converter 12 to the data converting circuit 13 is M1, and the data converting circuit 13 reads out, from the table corresponding to the mode signal M1, emphasis-use image data "0" which is in the address designated by the one-frame preceding image data "7" and the current data "4". The read out image data "0" is then output to the segment drive circuit 7, for the purpose of driving the liquid crystal panel 8. Here, as described above, the liquid crystal material used in the liquid crystal panel 8 has temperature dependency, and its response speed in relation to a change in the grayscale level becomes slower with a decrease of its temperature. On this account, the image data which is the minimum grayscale level of "0" is output to sufficiently carry out emphasis process with respect to the liquid crystal panel 8, so as to accelerate the response speed in relation to a change in a grayscale level, thereby causing the liquid crystal to swiftly follow the rapidly changing image.

[0018] As described, the same number of image data tables as the mode signals are stored and set beforehand, each of which tables containing image data whose address

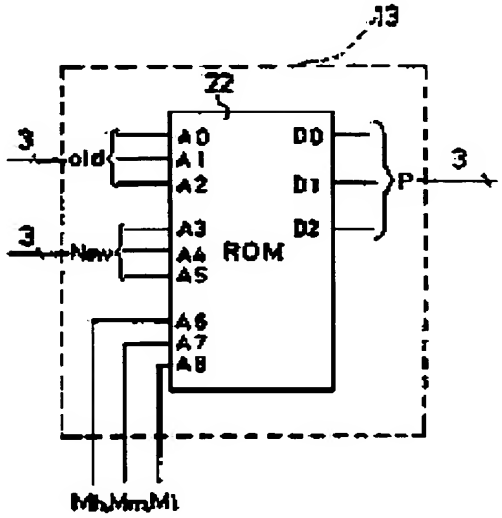
is designated by the current image data and one-frame preceding image data. One of these tables is selected according to the mode signal corresponding to the detected temperature of the liquid crystal panel 8. From the selected table, emphasis-use image data which is written in an address designated by the current image data and the one-frame preceding image data is read out, and is transmitted to the segment drive circuit 7. This configuration prevents displaying of an unnatural image despite the variation in the temperature of the liquid crystal panel 8. Thus, it is possible to always keep a high response speed of a liquid crystal material in relation to a change of the grayscale level, and the liquid crystal material is able to swiftly follow a rapidly changing image.

[0019] The present embodiment deals with a case where the temperature of the liquid crystal panel 8 is directly detected by the thermo sensor 11. However, other methods such as the following are also possible. Namely, it is possible to share a detection signal output by a thermo detector usually provided to a power source for driving a liquid crystal panel 8. Alternatively, it is possible to detect drive voltage for a light source provided nearby a liquid crystal panel 8, and use the detection result as an indirect temperature detection signal.

[FIG. 1]


COMPLEX VIDEO SIGNAL
SYNC SEPARATION CIRCUIT
1
CONTROLLER
2
A/D
3
ADDRESS
MEMORY CONTROL
IN
RAM
OUT
4
Old
New
Mode
P
13
DATA RECEIVING CIRCUIT
COMMON DRIVE
6
LIQUID CRYSTAL PANEL
8
SEGMENT DRIVE
7
THERMO SENSOR
11
A/D
12

[FIG. 2]


13
22
3
old
A0
A1
A2
3
New
A3
A4
A5
ROM
A6
A7
A8
D0
D1
D2
P
3
M8,M7,M6